



**ALL SAINTS'  
COLLEGE**

Science Department

Year 12 Chemistry ATAR

## Test 7: Organic Synthesis

Name: \_\_\_\_\_

### Instructions to Students:

1. 50 minutes permitted
2. Attempt all questions
3. Write in the spaces provided
4. Show all working when required
5. All answers to be in blue or black pen, diagrams in pencil.

TOTAL
/

Final Percentage

## Multiple choice

1. Monomers are:
  - a. molecules that are found within a polymer.
  - b. short polymers.
  - ☒ c. molecules that react to form polymers.
  - d. individual polymer links.
2. Addition polymerisation occurs from:
  - a. monomers with single bonds only.
  - b. polymers with single bonds.
  - ☒ c. monomers with double bonds.
  - d. polymers with double bonds.
3. Which statement about polymers is true?
  - a. Addition polymers are biodegradable.
  - ☒ b. Condensation polymers are biodegradable.
  - c. Condensation polymers are not biodegradable.
  - d. None of the above
4. Thermoplastic polymers:
  - a. are recyclable because they can be dissolved and reused.
  - b. are not recyclable because they will not dissolve.
  - c. are not recyclable because they cannot be melted.
  - ☒ d. are recyclable because they can be melted and remoulded.
5. Addition polymers:
  - ☒ a. are made from one type of monomer.
  - b. are composed from various monomers competing with each other.
  - c. are made from two different monomers reacting together.
  - d. can only form polythene.
6. Fats and oils belong to a group of compounds known as triglycerides. Most fats are triglycerides that can be described as:
  - ☒ a. long chain saturated fatty acids attached to a glycerol backbone
  - b. long chain unsaturated fatty acids with cis-bonds attached to a glycerol backbone
  - c. short chain saturated fatty acids attached to a glycerol backbone
  - d. long chain unsaturated fatty acids with trans-bonds attached to a glycerol backbone
7. Condensation polymers:
  - a. produce water.
  - ☒ b. do not require double bonds to form polymers.
  - c. are limited to polyester plastics.
  - d. require water to catalyse the reaction.
8. Proteins are essential to life and found in all living things, some examples include:
  - a. amino acids, DNA, insulin, haemoglobin.
  - b. DNA, insulin, haemoglobin, glycine.
  - ☒ c. DNA, insulin, haemoglobin, polypeptides.
  - d. DNA, insulin, zwitterions, collagen.

9. Which of the following is not a synthetic material?
- a. Nylon
  - b. Lycra
  - c. Teflon
  - ☒ d. Silk
10. A micelle is:
- ☒ a. produced by soap action on grease.
  - b. a name of a detergent molecule.
  - c. an important step in the saponification process.
  - d. an organic molecule used to make soap.
11. Green chemistry is an initiative designed to:
- ☒ a. prevent pollution, treat chemicals to make them safe and dispose of them safely.
  - b. reduce pollution, neutralise chemicals and dispose of them.
  - c. treat pollution, reduce chemical waste, and produce disposal methods.
  - d. prevent pollution, use safe solvents and dispose of them quickly.
12. Atom economy means:
- a. the amount of product atoms less the amount used as reactants.
  - b. the percentage waste of atoms used to produce a product.
  - c. the molar fraction of reactants to products used to produce a product.
  - ☒ d. the fraction of the mass atoms in reactants to products as a percentage.
13. How does biodiesel differ from crude-based diesel?
- a. One has an oxygen molecule.
  - ☒ b. Biodiesel is an ester.
  - c. Diesel has up to 21 carbon atoms in a linear chain.
  - d. Biodiesel is made from fossils.
14. The two main processes for producing ethanol does not include:
- a. fermentation.
  - b. hydration of ethene.
  - c. the reaction of water and ethene.
  - ☒ d. the Haber process.
15. By what type of polymerisation is polythene made?
- ☒ a. Addition
  - b. Condensation
  - c. Multiplication
  - d. Neutralisation
16. What monomer is used to make PVC?
- a. Ethyne
  - ☒ b. Chloroethene
  - c. Ethane
  - d. Chloroethane

17. Which of the following substances will *not* act as a surfactant?

- a.  $\text{CH}_3(\text{CH}_2)_{16}\text{COOK}$
- ☒ b.  $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$
- c.  $\text{CH}_3(\text{CH}_2)_{14}\text{COONa}$
- d.  $\text{CH}_3(\text{CH}_2)_{12}\text{C}_6\text{H}_4\text{SO}_3\text{Na}$

18. Which reaction cannot have an atom economy of 100%?

- ☒ a.  $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$
- b.  $\text{CH}_2\text{CH}_2 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{CH}_2\text{OH}$
- c.  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
- d.  $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$

19. An ester link in a copolymer is made using:

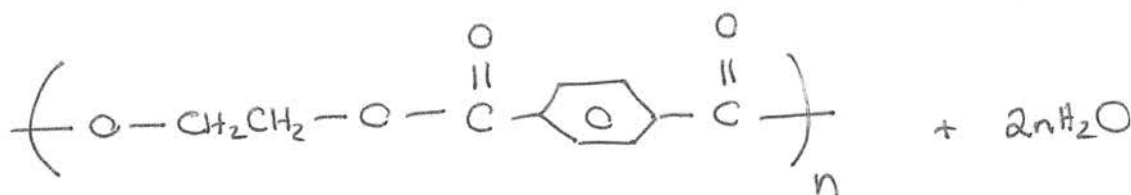
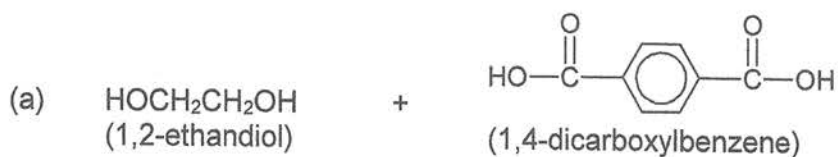
- a. a triester and sodium hydroxide.
- ☒ b. a dicarboxylic acid and a diol.
- c. an alcohol and a carboxylic acid.
- d. a monoester and acid.

20. Amino acids all contain:

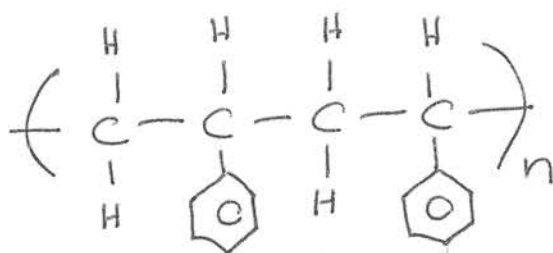
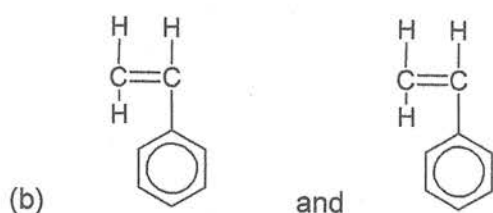
- ☒ a. amine and carboxylic acid groups.
- b. a carbonyl and amine group.
- c. an alcohol group.
- d. a ketone.

## Short Answer

1. Give the structure of the polymer formed by each of the following compounds under appropriate conditions by drawing a **dimer** for any **addition polymers** and the **smallest repeating unit** of any **condensation polymers**. You must also list any **by-products** formed in the reaction and you must state the **type of polymerization**.



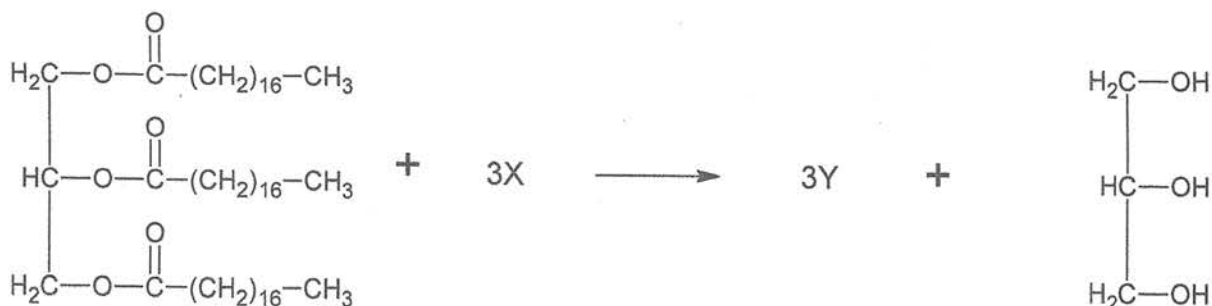
Polymerisation type: Condensation



Polymerisation type: Addition

[5 marks]

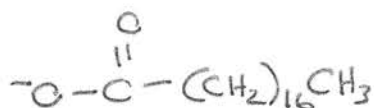
2. Consider the reaction:



(a) Give the name of the reactant X.

Sodium hydroxide (hydroxide ions)

(b) Write in one line the semi-structural representation of product Y.

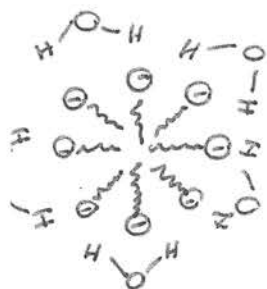


(c) Give a general name for this type of reaction.

Saponification

[3 marks]

3. (a) Explain in three or four sentences how a soap is able to dissolve in water and the process of "cleaning" a greasy plate using this soap once it is dissolved. Diagrams may be used.



Soap anions are able to dissolve in  $\text{H}_2\text{O}$  and form micelles. The hydrophobic tails of each anion dissolve in each other pushing the hydrophilic heads outwards which allows ion-dipole interaction with  $\text{H}_2\text{O}$ . (1)

If there is grease on the plate then soap micelles will crash into the grease globules. The micelle opens and tails of the anions dissolve in the grease. The grease becomes coated in anionic heads which interact with  $\text{H}_2\text{O}$ , allowing the grease to dissolve in  $\text{H}_2\text{O}$ . (1)

[3 marks]

(b) List three major differences between soaps and detergents.

- i. Soaps are made from renewable resources.
- ii. Soaps do not work in hard water.
- iii. Soaps have a carboxylate anion head, detergents sulfonate.

[3 marks]

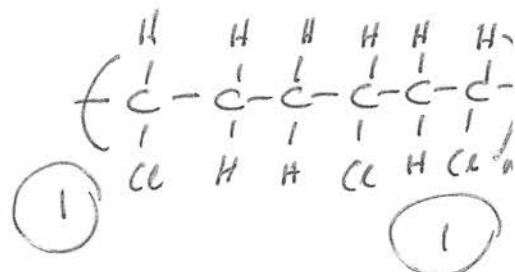
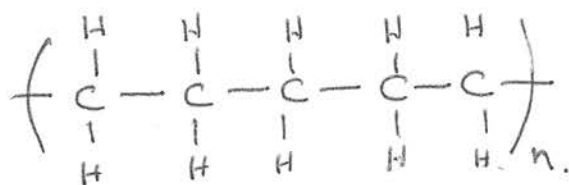
4. The cling plastics used in kitchens to wrap food were originally made from PVC (polyvinyl chloride). However there were concerns about the possible toxicity and leaching of plasticisers added to the PVC to produce the thin flexible film. As a result, this material is now made predominantly from LDPE (low density polyethene), even though in this form it is less "clingy" than PVC.

(a) What properties of LDPE make it suitable for use as a cling film?

- transparent
  - flexible but reasonably strong.
  - easy to manufacture + cheap
- } any two.

2

(b) Draw a partial structure for LDPE and PVC showing at least six carbons in the backbone.

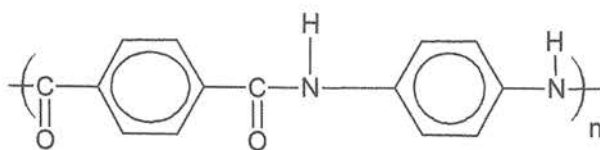


(c) Why would LDPE be less "clingy" than PVC?

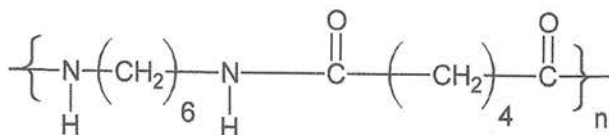
PVC has dipole-dipole interactions  
between the PVC chains. LDPE has  
only dispersive forces.

[5 marks]

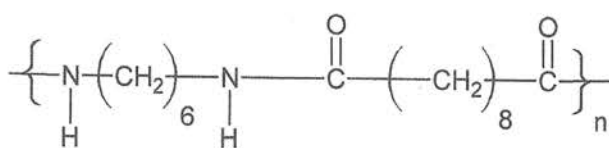
5. Consider the structure of Kevlar, nylon 6,6 and nylon 6,10:



Kevlar



Nylon 6,6



Nylon 6,10

- a. What is common to each of these polymers?

They are all condensation polymers -  
forms of Nylon.

- b. Which one of nylon 6,6 and nylon 6,10 would you expect to be more flexible?

Nylon 6,10.

- c. Which one of nylon 6,6 or nylon 6,10 would you expect to be stronger when used as a rope or fibre?

Nylon 6,6.

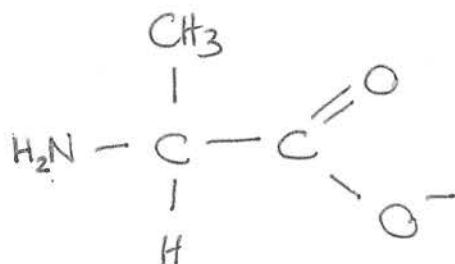
- d. Kevlar is used in bullet-proof vests, what about the structure of Kevlar makes it suitable for this use?

It has N-H and C=O groups close together  
along chains - greater H-bonding  $\therefore$  strength.  
Large benzene group - high dispersion forces.

5  
[4, marks]



6. There are many amino acids; alanine is just one of them. Show the zwitterion formed by the amino acid.



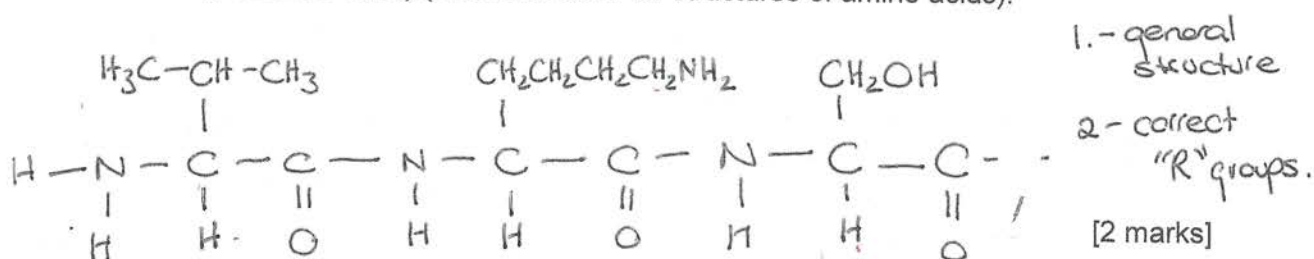
1 - structure

1 - correct charges.

[2 marks]

7. Valine, lysine and serine are three amino acids, which can combine to form proteins.

- (a) Draw the primary structure of a simple protein made from these amino acids (VAL-LYS-SER) (See data book for structures of amino acids).



1. - general structure

2 - correct "R" groups.

[2 marks]

- (b) Given the primary structure above, describe some of the interactions that would occur between chains of this protein in the tertiary structure.

Valine has a non-polar "R" group which would have dispersive interactions in the tertiary structure (1)

Lysine has a long carbon chain and -OH terminal group - dispersive and H-B interactions (1)

Serine has a short chain + -OH terminal group on the "R" portion - H-B interactions in the tertiary structure.

[3 marks]

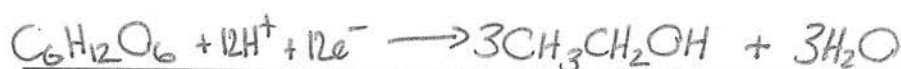
8. Ethanol is increasingly becoming a viable fuel alternative for a wide variety of applications. It has a number of production methods.

(a) Name the two types of chemical reaction through which ethanol is produced.

- fermentation
- addition

2 marks

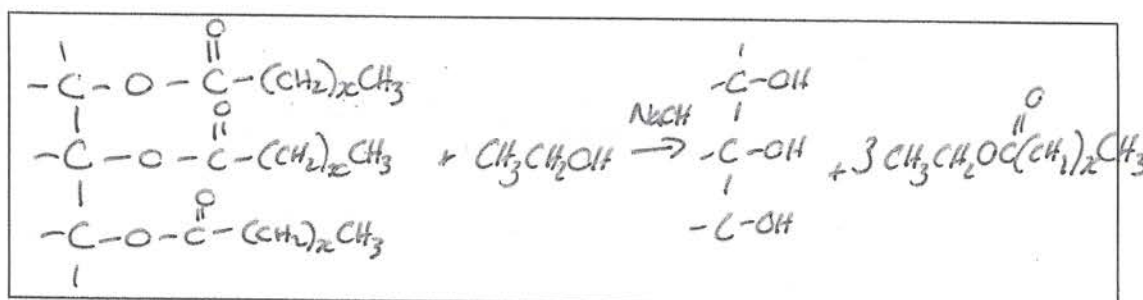
(b) Write the oxidation and reduction half equations for the fermentation of glucose to water, ethanol and carbon dioxide.



a general.

2 marks

(c) Write an equation for the production of biodiesel using ethanol rather than the traditional methanol.



2 marks.

End of Test